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JUL 28 1938

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE



FOREST RESEARCH ACTIVITIES

FOREST MANAGEMENT
WATERSHED MANAGEMENT
FOREST PRODUCTS

FOREST ECONOMICS
RANGE MANAGEMENT
FOREST SURVEY

MAY - 1938



FOREST RESEARCH

MONTHLY REPORT

May 1938

Genetics -
pp. 27-28
copied
8/6/40

NOTICE

With this issue, the Forest Research Activities Report will be discontinued for the months of June, July and August. Material for the September issue is due in Washington October 10, 1938.

GENERAL

Lake States

Tri-State Forestry Conference. To find out how to correlate conservation activities in the three adjoining states and how to work as a unit in the matter of regulating private forestry was undoubtedly the underlying reason for the Tri-State Forestry Conference called at St. Paul May 20-21. Some 200 foresters, lumbermen, economists and others from Wisconsin, Minnesota and Michigan assembled for the two-day meeting.

Formal talks covered the whole field of land use, forest management, public works, public acquisition, etc. The most significant discussions, however, dealt with the problem of reverting tax delinquent land and regulation of private forestry.

John Levine, who has been on two special forestry commissions in Minnesota, apparently expressed the feeling of the meeting when he spoke of his State as being far advanced in land use planning but nowhere in performance. The discussions also brought out the point that none of the three states has satisfactorily solved the problem of reimbursing counties and school districts for property taken from the tax rolls. Desirability of coordination between states was emphasized.

Regulation of private lumbering operations was recognized as desirable by most speakers. But differences in approach were indicated. O. T. Swan, Secretary of the Northern Hemlock and Hardwood Association, said that few, if any, operators in the region could plan for sustained yields under present economic conditions. They are quite willing to cut under a selective logging plan if the state or federal government would purchase the land and residual timber. Dean S. T. Dana, University of Michigan, advocated public regulation but not along arbitrary or purely biological lines. He favored a plan whereby competent foresters in the employ of lumber companies would work out plans of management to be approved by the Conservation Departments. The general conclusion reached was that any regulation attempted should be handled through the state departments.

At the banquet Dr. Zon emphasized the necessity for foresters to plan for the present generation as well as for the future.

Moving Day is Here - June 7th. The Lake States Forest Experiment Station is moving into Green Hall, the new Forestry Building. Quarters will be on the third floor and will be sufficiently large to accommodate the entire organization, making it unnecessary for the Forest Survey to maintain a separate office in the New Post Office Building.

Pacific Northwest

General. The announcement made on May 25 that Stephen N.

Pacific Northwest (cont'd.)

Wyckoff was to be transferred as Director of this Station met with general approval.

The Advisory Council held its annual meeting as an overnight field excursion at Wind River on May 24 and 25. The party of about 25 gathered for dinner at the mess hall, which Supervisor Cecil had opened for the occasion. After dinner the group strolled through the arboretum and then held a 2-hour session in the laboratory at which several members of the Station staff sketched their past year's work and proposed program. David T. Mason presided. Officers for the ensuing year were re-elected, namely, Mr. Mason as Chairman, State Forester Goodyear as Vice Chairman, and T. T. Munger as Secretary. On the following day a circuit of the Wind River Valley was made, making scheduled stops at which Munger, Isaac, Matthews, Pickford, and Brandstrom each explained some phase of experimental projects. Twelve members of the Council or their representatives were present.

At the commencement exercises at Oregon State College the honorary degree of Doctor of Science was conferred upon Munger. This is the first time that forestry has been so recognized by a university in the Northwest.

FOREST MANAGEMENT

SILVICULTURE

California

Forest Management - Pine Region.

Sustained Yield - Blacks Mountain. Resumption of insect-control salvage cutting in the Blacks Mountain Experimental Forest will be delayed until about June 15 because of the very late spring. The extremely wet winter made lakes of sagebrush flats and raised water levels over roads in some places. Construction at headquarters and preparations for logging were resumed late in May. Plans call for delivery to the cooperating lumber company of about three million feet of logs during the season.

Establishment of a random-block methods-of-cutting study was begun late in May. Three cutting systems will be tested - standard Forest Service, economic selection, and the flexible silvicultural treatment which is the foundation of the sustained yield project.

Methods-of-cutting. Several discussions of Regional marking changes and a field test on the Eldorado were participated in by Woodbury, Berry, and Kevin of the Regional Office, Weber of the Eldorado, Salman of the Bureau of Entomology and Plant Quarantine, and Dunning of the Station. The policy of lighter cutting involves leaving larger,

California (cont'd.)

older trees than formerly. It is probable that a sub-class in the Class 5 trees will be made to aid the marker in selecting about 15 or 20 percent more volume for reservation in relatively vigorous trees over 300 years old.

Northern Rocky Mountain

Light Intensity Related to Stand Density. Recently completed by Wellner is an analysis of light intensity measurements made last summer under stands of various densities in the western white pine type. The purpose of the study was to relate light intensity to stand density. It is known that density of the overwood stand exerts a profound effect on the establishment and subsequent development of reproduction and it was desired to investigate the practicability of using light intensity as a single and convenient measure of stand density.

A Shirley radiometer was used to measure light intensity and 100 measurements were made on each of 36, 4/10-acre plots located in a wide variety of virgin and partially cut-over stands. Stand density was measured (1) by summations of tree diameters at breast height; (2) by tree basal area at breast height; and (3) by number of trees. Of these units of measurement, summations of tree diameters gave the highest correlation with light intensity expressed as percentage of full sunlight received beneath the overwood stand. Correlation with the basal area was but little lower. Number of trees, however, showed, as might be expected, a low and unreliable correlation with light intensity.

A useful result of this study is that stand density as measured in easily obtained units of diameter summations or basal area can be expressed with a fair degree of accuracy in terms of light intensity as a percentage of full sunlight, or vice versa. Before, no such conversion was possible. The following table shows this relationship.

			Overwood stand density as measured by:		
Mean light intensity beneath the canopy expressed as percentage of full sunlight	: Tree basal area per acre for stands composed mainly of species indicated	:	Summation of diameters in inches per acre for stands composed mainly of species indicated	:	
	Western white pine, western larch, Douglas fir	Lowland cedar, western hemlock	Western white pine, western larch, Douglas fir	Lowland cedar, western hemlock	
Percent	Square feet	Square feet	Inches	Inches	
10	425	265	4,000	2,350	
20	330	155	3,200	1,650	
30	250	115	2,500	1,300	
40	190	90	2,000	1,050	
50	140	70	1,600	850	
60	105	55	1,250	650	
70	70	35	850	450	
80	45	20	550	300	
90	20	10	250	150	
100	0	0	0	0	

Application of this information can best be illustrated by an example. Assume it is known that best seed germination and early survival of reproduction on a lower south slope can be had under 60 percent of full sunlight. Given this information, the timber marker needs to know how many trees of various sizes are needed to intercept 40 percent of full sunlight. The above table shows that 1,250 inches of summated tree diameters are required if the stand is composed mainly of western white pine, western larch, and Douglas fir, and 650 inches if composed mainly of lowland white fir, western red cedar, and western hemlock. Given any average tree diameter, these summated diameters can readily be converted into number of trees per acre to give the timber marker the desired information on how many trees to leave.

Another useful finding of this study was that discontinuous measurement of light intensity as a percentage of full sunlight can be obtained within 5 percent without expensive instruments. It was observed that the foliage of tree crowns exerted little filtering effect on the passage of light; that is, sun rays either penetrated the canopy unimpeded or else were almost entirely obstructed by foliage. As a result, most light measurements were either of very high or very low intensity. Utilizing this observed fact, a formula was devised as follows:

$$\text{Mean light intensity beneath the canopy as a percentage of full sunlight} = \frac{A(100) + Bx}{100}$$

Northern Rocky Mountain (cont'd.)

Where

A = percentage of individual measurements greater than 50 percent full sunlight,

B = percentage of individual measurements less than 50 percent full sunlight,

x = average intensity of reflected light (about 7 percent),

100 = intensity of full sunlight.

Values for A and B can be obtained by inexpensive equipment such as cheap photoelectric cells or extinction meters used in ordinary photographic work, or even by ocular estimate. The value x is a fairly stable constant. This formula was tested on a number of plots used in this study and in all cases the light intensity percentage as determined by formula deviated less than 5 percent from the value determined by instrumental measurement.

Pacific Northwest

Experimental Forests. Each year classes of foresters from different schools visit the experimental forests and study the work under way. During May a group of students with three professors from Oregon State College visited Cascade Head Experimental Forest, a group of students and two professors from Montana State visited Wind River Experimental Forest, and a third group with two professors from the University of Washington visited Pringle Falls for three days and Wind River for two days.

Douglas Fir Region. During the early part of the month the two plots selectively logged (in 1935) on the Port Orford Cedar Experimental Forest were reexamined. One plot along the river that was clear cut in spots and had a very light mixture of young cedar now has an abundance of white fir and Douglas fir seedlings in the larger openings and from present indications the percentage of Port Orford cedar in the future stand will be much less than in the original stand. The second plot, on the other hand, had considerable advanced Port Orford cedar reproduction and new reproduction of Port Orford cedar and Douglas fir is becoming established in the openings made by the cutting. On the latter area the result will quite likely be an increase in the percentage of Port Orford cedar in the stand, which is highly desirable.

Thinning and Pruning Douglas Fir. In cooperation with the Office of Plant Pathology another plot was added to the pruning study series in young Douglas fir on the Wind River Experimental Forest. The new plot has been established to study the effect of method, severity, and season of pruning on incidence of decay. Five types of

Pacific Northwest (cont'd.)

treatment, which are to be duplicated at the end of the growing season, were each applied to 20 dominant and codominant trees, the treatment being assigned by random selection. Annual examination is to be made by local representatives of the Office of Plant Pathology and previously designated trees are to be dissected by them at 5-year intervals for study of location, entrance court, and extent of decay.

Southern

Improvement Cutting in Loblolly-shortleaf-hardwoods. In April and May, the first 5-year remeasurement of a 15.5-acre improvement cutting experiment at Urania, La., was made. Preliminary analysis reveals a striking increase in growth rate as a result of the cutting.

In the spring of 1933, the stand of loblolly and shortleaf pines and mixed hardwoods in which the plots were established was ragged or irregular in form and density, definitely understocked as a whole, and much in need of an improvement cutting. The original timber had been cut about 30 years previously and the 1933 stand was composed largely of second-growth pine about 25-30 years old, intermixed with large hold-over pines and hardwoods. Before improvement cutting, the stand contained 4,260 bd. ft., International 1/4 inch rule, and 10.9 cords of pulpwood (including 1.9 cords in the tops of sawlog trees). The improvement cutting removed an average of 1,096 bd. ft., International 1/4-inch rule, and 3.4 cords of pulpwood per acre (including 0.4 cord from the tops of sawlog trees) from 31 quarter-acre plots. The remaining 31 quarter-acre plots were left uncut. In addition, 15.4 unmerchantable hardwoods per acre 10 inches and more in d.b.h., were girdled on the treated plots.

The following table summarizes the d.b.h. growth and mortality for all pines in and above the 4-inch class as of 1933.

Southern (cont'd.)

Summary of 5-year D.B.H. Growth and Mortality on Urania Improvement Cutting Experiment

						Difference in		
Treated			Check			ave. D.B.H.		
D.B.H.: Mortality:	:Growth of	: Mortality:	:Growth of	:growth in favor				
class	:trees dying in	: trees	:trees dying in	: trees	:of treated plots			
in	: 5 yr. period	:that lived	: 5 yr. period	:that lived	:Inches	:Percent		
1933	:	:	:	:	:	:	(more	
	No. :Percent	:trees:D.B.H.: No.	:Percent	No. :D.B.H.:	than	: than		
	: :growth:	:	:	:trees:growth:check)	:check)			
			Inches			Inches		
4	11	4.7	222	0.474	28	9.7	260	0.221
5	3	3.2	90	0.862	6	3.8	153	0.437
6	3	3.6	81	1.042	0	0	84	0.662
7, 8	0	0	96	1.193	1	0.9	106	0.903
9,10	0	0	41	1.421	0	0	41	1.254
11-21	0	0	43	1.635	0	0	33	0.323
Total	17	2.9	573		35	4.9	677	

The data were obtained from 31 treated tenth-acre plots and 31 check tenth-acre plots on which all pines in and above the 4-inch class were numbered in 1933. The tenth-acre plots are centered within the quarter-acre plots, hence have isolation strips. The table shows clearly that the d.b.h. growth on the treated plots has consistently and substantially exceeded the d.b.h. growth on the check plots, and that the mortality--confined to the smaller trees--has been much larger on the check plots. The mortality figures were expected, but the difference in d.b.h. growth is much larger than was expected for the first five years.

It is planned to continue making light selective cuttings at 5- or 10-year intervals to improve the composition and growth rate while gradually building up the growing stock. Except for the girdling of the larger unmerchantable hardwoods, only trees merchantable for sawlogs, pulpwood, or other products were, or will be, cut.

Longleaf Pine Competition. Five year measurements of height and diameter of longleaf pine seedlings on the competition-density plots at Bogalusa were completed. The striking increases in height and diameter over the 5 year period are shown in the following table:

Southern (cont'd.)

Average Height and Diameter Increases of
Longleaf Pine Seedlings in 5 Years as Affected by
Density and Grass Competition

Number of seedlings (Thousands)	Plots denuded of:		Plots not denuded		Differences in favor of denudation	
	grass	Percent increase per acre in 5 years	Percent increase in 5 years	Diam.	Height	Diam.
	Height	Diam.	Height	Diam.	Height	Diam.
- - - - - Percent - - - - -						
1	5782	563	3109	426	2673	137
5	4785	466	1461	321	3324	145
10	2007	285	991	299	1116	-14
15	1517	251	920	292	597	-41
25	1433	214	394	260	1039	-46
50	631	228	274	260	357	-32
100	419	187	158	199	261	-12

Washington Office

Soils. An article worth reading by those interested in practical methods of determining wilting points of soils is:

Bouyoucos, G. J. "A rapid method for determining the permanent wilting point and for indicating under field conditions the relation of soil moisture thereto." Soil Science 45:1: 47-56, January, 1938.

MENSURATION

California

Redwood Felling Breakage. In the redwood region, steep and broken topography and a very brittle species result in unusually high breakage in felling. As yet all data collected by the Experiment Station on breakage have been incidental to other studies and consist only of total amounts; consequently no information regarding reduction of this high

California (cont'd.)

breakage is presented. However, the amounts of breakage found on one operation in Mendocino County have been analyzed in relation to tree size and are presented in table 1 as they should be of considerable value in connection with cruising.

In volume tables now being prepared the top diameter inside bark is expressed as a percentage of diameter inside bark at 20 feet above the base. This method of providing standard top diameter classes was used because although top diameters vary both among companies and within companies they are roughly proportional to basal diameters. Consequently breakage is expressed as a percentage of the gross volume of the tree from a 3.5 foot stump to these standard top diameters. Breakage includes all material from which a 16-foot log could not be cut.

The analysis showed little relationship between percentage of breakage and tree diameter. There was a distinct relation between percentage of breakage and height as shown in table 1.



California (cont'd.)

Table 1.- Redwood felling breakage 1/

Height in feet to top d.i.b.	Top d.i.b. 2/ 50 percent			Top d.i.b. 2/ 60 percent			Top d.i.b. 2/ 70 percent		
	Sound :Goosepen			Sound : Goosepen			Sound:Goosepen		
	trees : trees			trees : trees			trees: trees		
	Percent ^{3/}	Percent ^{3/}	Percent ^{3/}	Percent ^{3/}	Percent ^{3/}	Percent ^{3/}	Percent ^{3/}	Percent ^{3/}	Percent ^{3/}
40							.0		
50							.4		
60	6.1			3.5			1.2		
70	6.7			4.1			2.0		
80	7.4			4.8	.6		2.8		
90	8.0	9.8		5.4	2.5		3.6	5.1	
100	8.6	10.9		6.0	5.0		4.4	8.3	
110	9.2	12.0		7.2	10.0		5.2	11.5	
120	9.8	13.0		7.8	12.5		6.0	14.7	
130	10.5	14.1		8.4	15.1		6.8	17.9	
140	11.1	15.2		9.0	17.6		7.7	21.1	
150	11.7	16.2		9.6	20.1		8.5	24.2	
160	12.3	17.3		10.3	22.6		9.3		
170	13.0	18.4		10.9			10.1		
180	13.6	19.5		11.5					
190	14.2	20.5		12.1					
200	14.8			12.7					
210	15.4			13.3					
220	16.1								

1/ Includes loss from rot which prevents cutting of logs.

2/ Top diameter inside bark expressed as ratio of top d.i.b. to d.i.b. at 20 feet above ground.

3/ Straight lines fitted to data by method of least squares.

The breakage for goosepen trees does not include cull from the hollow butt itself and so cannot be used for total cull. It is only included to show in a general way that breakage in the upper part of the bole is greater because fallers have less control over hollow butted trees. No figures expressing complete cull for such trees can be given until studies are made wherein the trees are followed through bucking and the cull from the hollow butt itself is determined. The figures for sound redwood do not include cull in the portion of the tree made into logs. Until more definite figures are available, however, the 30 percent deduction as used in the Humboldt scale can be used as a close approximation for the cull in the logs to be utilized. The results of this study apply only to Mendocino County.

Pacific Northwest

Growth of Ponderosa Pine. Periodic remeasurements were made by Briegleb on the three Deschutes growth study permanent sample plots established ten years ago in 60-year-old even-aged ponderosa pine. These are the only permanent growth study plots in this type of stand in the region and their record, though brief, reveals possibilities of large yields for this species on sites capable of supporting well-stocked, even-aged stands.

Growth of the Spruce-Hemlock Type. Briegleb also made periodic remeasurements of the two Clatsop and the two Crown-Willamette growth-study permanent sample plots in even-aged, spruce-hemlock stands. This is the first 5-year remeasurement of the Clatsop plots established in a 40-year-old stand and the second for the Crown-Willamette plots which were established in an 80-year-old stand. Though the latter plots were established but ten years ago, they are the oldest in the spruce-hemlock type in the region. Plots established subsequent to these bring the total for this highly productive type to 17. Computations of the data collected are under way.

Southwestern

Design of range experiments. A recently submitted plan for an experiment containing several unusual features in its design, is based on the concepts that:

1. In grazing experiments the required efficiency can be achieved only by confining the experimentation to small areas upon which complete control of treatments can be maintained and precise measurements of all essential factors in their entirety can be made.
2. A consistent degree and a regular rate of forage removal can be accomplished only by hand clipping or other equally tractable method of artificial grazing.
3. Season of experimentation should coincide with the season of grazing use. Grasses that are primarily winter forage should be studied under conditions which include a systematic, progressive rate of forage removal during fall, winter, and spring months. (Summer forage species should be treated in a similar manner during the summer months.)
4. Large pastures should be employed only as the "proving grounds" where the more promising results obtained from experiments conducted on small areas may be tested out by grazing livestock under practical range conditions.

The proposed experimental design provides for 11 clipping treatments and a check plot arranged in a 12 x 12 Latin square. It is

Southwestern (cont'd.)

realized that in agricultural experiments a Latin square beyond an 8 x 8 is undesirable. Whether this condition is also true of range experiments remains to be seen. The arrangement of the design need not be a point of indecision. Fortunately the initial tuft areas and numbers of plants will be available concomitant measurements. Should conditions on the ground at the time if and when the experiment is set up indicate that a randomized block design would be more efficient, it should be substituted for the Latin square.

If this change should be necessary, it will not affect the treatments listed and described in table I. Treatments 1 to 4, inclusive, provide for the monthly clipping of a prescribed equal percentage of each tuft spread over a 4-month period. The balance to be left intact at the end of the period is indicated in the last column. Treatments 5 to 8, inclusive, are identical with 1 to 4, but spread over an 8-month period. Treatments 9 to 12 are self-explained, except that 11 and 12 are to be clear cut and covered with cheesecloth or other light fabric to prevent wind erosion.

Southwestern (cont'd.)

TABLE I - Treatment Schedule*

(Percent to be cut each month and balance left)

Treatment	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Balance
	: 1 : %	: 1 : %	: 1 : %	: 1 : %	: 1 : %	: 1 : %	: 1 : %	: 1 : %	%
I - Clipping 4 months									<u>Feb. 1</u>
T 1	25	25	25	25	-	-	-	-	0
T 2	22½	22½	22½	22½	-	-	-	-	10
T 3	20	20	20	20	-	-	-	-	20
T 4	17½	17½	17½	17½	-	-	-	-	30
II - Clipping 8 months									<u>June 1</u>
T 5	12½	12½	12½	12½	12½	12½	12½	12½	0
T 6	11¼	11¼	11¼	11¼	11¼	11¼	11¼	11¼	10
T 7	10	10	10	10	10	10	10	10	10
T 8	8-3/4	8-3/4	8-3/4	8-3/4	8-3/4	8-3/4	8-3/4	8-3/4	30
III - Site Treatment									
T 9	100	-	-	-	-	-	-	-	Cut every- thing
T 10	0	-	-	-	-	-	-	-	Cut nothing
T 11	-	-	-	100	-	-	-	-	Cut every- thing and cover
T 12	100	-	-	-	-	-	-	-	Cut every- thing and cover

*Clipping height 2 inches above root collar.

Southwestern (ccnt'd.)

The analysis of variance, table II, shows the sub-division of the degrees of freedom for a 12 x 12 Latin square.

TABLE II - Analysis of Variance

Source of Variation	:	Degree of Freedom
Total		143
Between means of rows		11
Between means of columns		11
Between means of treatment		11
Error		110

The 11 degrees of freedom allotted to treatments may be assembled in orthogonal sets of comparison as shown in table III. These 11 independent comparisons should increase the precision of the experiment tremendously.

Southwestern (cont'd.)

TABLE III - Orthogonal Sets of Comparisons

Comparisons	TREATMENT											
	Sec. I - 4 mos.				Sec. II- 8 mos.				Sec.III-Site			
	Treatment No.											
	: 1	: 2	: 3	: 4	: 5	: 6	: 7	: 8	: 9	: 10	: 11	: 12
Progressive 100% clip; 4 vs. 8 mos.	+1	0	0	0	-1	0	0	0	0	0	0	0
Progressive 90% clip; 4 vs. 8 mos.	0	+1	0	0	0	-1	0	0	0	0	0	0
Progressive 80% clip; 4 vs. 8 mos.	0	0	+1	0	0	0	-1	0	0	0	0	0
Progressive 70% clip; 4 vs. 8 mos.	0	0	0	+1	0	0	0	-1	0	0	0	0
Leaving nothing vs. 10% or more	+3	-1	-1	-1	+3	-1	-1	-1	0	0	0	0
Leaving 10% vs. 20% or more	0	+2	-1	-1	0	+2	-1	-1	0	0	0	0
Leaving 20% vs. 30%	0	0	+1	-1	0	0	+1	-1	0	0	0	0
Progressive and artificially Protected clip vs. instant total unprotected	+1	+1	+1	+1	+1	+1	+1	+1	-10	0	+1	+1
Clipping vs. no clipping	+1	+1	+1	+1	+1	+1	+1	+1	+1	-11	+1	+1
Instant total with artificial protection vs. progressive clip	-1	-1	-1	-1	-1	-1	-1	-1	0	0	+4	+4
Artificial protection 4 vs. 8 mos.	0	0	0	0	0	0	0	0	0	0	+1	-1

The previously described experiment was designed for the study of black grama. However, with slight changes it may be adapted to many other winter forage grasses.

Southwestern

Growth and Yield: Ponderosa Pine. Further analyses have been made of increment and mortality in relation to diameters on a 455-acre cut-over ponderosa pine plot which has been under record 20 years. Previous accounts of this analysis were presented in the monthly reports for January (p. 16) and March (p. 10). Gross increment percent referred to the 1913 board foot volume plotted on diameter gives a graph that declines rapidly and quite uniformly from 12 to 30 inches, then tends to flatten out. In these figures the trees that died during the 20-year period were eliminated, and thus the increment percent is not affected by mortality. Mortality percent, also referred to the 1913 board foot volume, rises slowly from 12 to 22 inches d.b.h., then more rapidly, becoming decidedly steep beyond the 30-inch class. At about 31 inches the increment curve and the mortality curve cross each other indicating that beyond this diameter mortality exceeds increment. Beyond 30 inches d.b.h., mortality exceeds 1 percent annually, whereas the increment falls to 1 percent at 32 inches and considerably less at 38 inches.

Another plot of 480 acres recorded over a period of 25 years shows a similar relation, but since the trees were not numbered and recorded individually from the beginning, it is not possible to plot the data in the same way. Results on the 455-acre plot are summarized by broad diameter groups in the following table.

D.B.H. Class			: Annual : : increment: Annual : percent : mortality : grass : percent	
	: Number : Volume : : of trees : M.B.M. : 1913-1933*: 1913-1933*			
12 - 20	2,369	266	5.07	0.26
21 - 30	980	559	2.23	0.62
31 - 47	113	177	1.00	1.42
12 - 47	3,462	1,002	2.77	0.71

* Based on board-foot volume.

Washington Office

Some recent material on statistical theory:

1. Malenbaum, Wilfred, and Black, John D. The use of short-cut graphic method of multiple correlation. Quarterly Journal of Economics, Vol. LII, No. 1 : 66-112. November, 1937.

Presents a critical discussion of Bean's short-cut graphic method, Ezekiel's approximations, and formal mathematical correlation.

This article is most timely in that it brings out into the open for discussion methods of correlation analysis which though having had widespread use have not been acceptable to a considerable group of statisticians.

The concluding paragraph is:

"Future developments in correlation analysis are likely to follow graphic lines more than mathematical. The nature of the problems to be analyzed and the conditions of use of the results are such as almost to insure such an outcome. The course of progress therefore seems to be in improving the use of graphic methods. The phase of this which is most important at the moment is in the nature of analyzing different forms of graphic technique, and classifying, standardizing, and testing them. Users of these methods must be able to describe more categorically what they have done, and present their results in such form that they can be more effectively checked and tested."

2. Cochran, W. G. Some Difficulties in Statistical Analysis of Replicated Experiments. The Empire Journal of Experimental Agriculture. Volume VI. No. 22. April, 1938.

This is a most excellent treatment of the subject of transformations of data in order that the analysis of variance technique be applied with validity. The topics discussed are (1) how to tell from an inspection of the data if a transformation is needed; (2) types of data which may require special treatment; (3) descriptions of the three most useful transformations in practice (square root, inverse-sine and logarithmic) their possibilities and limitations with each adequately illustrated with numerical examples; and (4) the use of transformations in factorial experiments. Especially recommended.

3. Smith, H. Fairfield. An Empirical Law Describing Heterogeneity in the Yields of Agricultural Crops. Journal of Agri. Science Vol. XXVIII Part I. pp. 1-23. Jan. 1938.

Using data of a uniformity trial in wheat it was found that the regression of the logarithm of the variances for plots of different areas on the logarithms of their areas was approximately linear. This hypothesis was tested by examination of thirty-nine other uniformity experiments. On the basis of this expression average relative efficiencies to be expected for randomized block experiments with varying numbers of plots per block may be indicated. Also formulas are made available for estimating the most efficient size and the cost indicated of using plots other than the most efficient.

4. Uspensky, J. V. Introduction to Mathematical Probability. First edition 411 pp. N. Y., McGraw-Hill Book Company, Inc., 1937.

Washington Office (cont'd.)

As stated by the author this book is an outgrowth of lectures on the theory of probability given at Stanford University over a number of years. The first twelve chapters giving an elementary treatment of the theory of probability may be read with understanding by persons without advanced training in mathematics. The remaining chapters are devoted to the results of modern investigations and are recommended to those interested in gaining a better concept of the theoretical basis for modern statistics. While no attempt is made to show the applications of probability to other sciences the value of this text is enhanced by the large number of illustrative problems included.

5. The Kelley Statistical Tables by Truman L. Kelley, 1938. N. Y., The MacMillan Company. The following tables are given: Eight-Place Normal Distribution, Simple Correlation, and Probability Functions; Four-Place Chi-Square Functions; Ten-Place Cubic and Quintic Interpolation Coefficients; Eleven-Place Septic Interpolation Coefficients; Eight-Place Square Roots; Constants Frequently Needed. Price \$4.50.
6. New editions of several standard texts on statistics have appeared. Two of these are:

Yule, G. Udny and Kendall, M. G. An Introduction to the Theory of Statistics. Eleventh Edition, 1937. Philadelphia. J. B. Lippincott Company.

A noteworthy addition is the very complete list of references appearing at the end of the book. These are very well classified, first appear those of general interest on the Theory of Statistics, Probability and related subjects; next those on particular topics as treated by chapters in the text, and references to statistical tables useful in computational work. This edition differs from earlier ones mostly in the form of additions of several new chapters on the subjects in Statistics receiving emphasis at the present time.

7. Lippett, L. H. C. The Methods of Statistics, an Introduction Mainly for Experimentalists. 2nd edition 1937, London: Williams and Norgate, Ltd.

This edition represents considerable rewriting of particular chapters to include enlarged discussions of the modern statistical theory which is of special importance in experimental work. This book may be of value to those who frequently find Fisher's "Statistical Methods for Research Workers" difficult to follow.

Regeneration

California.

Results of Examinations.

Forestation. Spring examinations of two brush field plantations at Burney Spring show good germination in fall-seeded spots. Thinning of

California (cont'd.)

seed spots planted in the spring of 1937 was completed. Little winter loss was evident. Preliminary examinations indicate that some of the damage resulted from the rezyl-strychnine rodent spray used and is similar to injury which appeared in greenhouse tests.

Landscape Nursery. Recent research has been largely concerned with the discovery of methods of germinating refractory seeds of native California plants. One of the most refractory is Eriodictyon californicum. After stratification at 0° C. for varying periods, a maximum germination of 54 percent in 27 days has been secured. This maximum was attained after a stratification period of four months. The work will be continued to determine the length of treatment at which optimum results are secured.

Lake States

Thinning of Coniferous Seedlings in the Nursery. In order to determine the value of late spring thinning of seedlings in dense seedbeds, an experiment was laid out at the Hugo Sauer Nursery, Rhinelander, Wisconsin by J. H. Stoeckeler and H. A. Barton.

Third-year seedlings of white and red pine growing at a density of 125 per square foot were root pruned at a depth of 3-1/2 to 4 inches and thinned to 25, 50, and 75 per square foot during the latter part of June 1937.

Measurements taken at the end of the 1937 growing season indicated that the stock was benefited by increasing its average weight and stem diameter. However, an entirely different picture of the value of the thinning is obtained by computing the number of plantable trees produced per square foot as shown in the following table:

Density per Sq.Ft. in Seedbed	No. of trees per square foot of seedbed by diameter classes			
	5/64 inch or over	6/64 inch or over	7/64 inch or over	8/64 inch or over
25	24	22	19	16
50	46	44	26	18
75	72	60	33	21
125	110	95	40	35

The table shows a greater number of plantable trees per square foot in the unthinned beds, regardless of what is set up as the minimum acceptable stem caliper.

From the results obtained, it is evident that late spring thinning

Lake States (cont'd.)

of white and red pine seedlings is not justified and it is probable that such thinning should be done not later than the spring of the second year.

Stratification of Honeylocust Seed. The possibility of substituting stratification for the usual acid treatment method of hastening the germination of honeylocust seed has presented itself as the result of germination tests on seed which had laid on the ground for a part of the winter. About 25 percent of the seed in the pods picked from the ground in mid-March were swollen to more than double their normal size and had soft coats while the remaining seed was only slightly swollen and had considerably harder coats.

Four hundred seed of each class were sown in sand flats and germinated at a temperature fluctuating from 68 to 85 degrees F. The germinative energy of the large swollen seeds was 27.8 percent in 5 days; for the small seeds 41.5 percent in 21 days. The total germination at the end of 34 days was 30.0 percent for the swollen seeds and 53.2 percent for the small seeds.

Although the total germination was considerably higher than that usually obtained from untreated seed (9 percent in 50 days), it was much lower than for acid treated seed (about 80 percent). However, better results may be obtained if the stratification period were lengthened. In the present case the duration of this period is not known but it can not be said to have been all winter, as many pods still remained on the trees at the time of collection. The poor showing made by the large swollen seeds may have been due to a heavy growth of mold which was found to have developed around the seed while it was in the ground.

Seed Testing Statistics. A total of 123 seed samples were tested for Region 9; 8 for the state of Illinois, and 15 for individuals. Experimental tests were also made on some 62 other samples.

Approximately 280 sand flats have been sown this spring. An especial effort will be made to obtain information on seed which ripens in late spring.

Southern

Nursery. In the nursery phase, computations have been completed for the 1937 soil amendment and cultivation-watering studies and are ready for interpretation. The long-time fertilizer-rotation study was continued, and new studies of effect of compost upon optimum density and of fertilizer and fungicide combinations upon brown-spot infection, were installed.

Spacing Plantations. The fifteen-year remeasurement of the loblolly spacing plantations (5 x 5, 6 x 6, and 8 x 8 feet) at Bogalusa was completed, and computations are well under way. It appears possible, by breaking the plots down into quarters and eighths, to analyze the data for variations both within and between plots, and hence to obtain a fair test of significance of the differences resulting from spacing, despite defects in the original experimental design. Averages

Southern (cont'd.)

obtained from the 15 year remeasurement are presented in the following table:

Measurements in 15 Yr. Old Loblolly Pine Spacing Plantations

Item	Spacing in Feet		
	5 x 5	6 x 6	8 x 8
D.b.h., inches	4.45	4.81	5.69
Total height, feet	31.59	30.65	29.67
Dead length, feet	17.09	14.56	13.06
Clear length, feet	4.56	4.09	3.26

These figures show the relatively small effect of spacing upon height growth, and the distinct effect upon diameter growth and upon killing of branches by shading. Mortality figures, cordwood yield figures, and some interesting figures on Cronartium infection remain to be worked up.

Seed. Laboratory work was completed and computations begun on the study of longleaf and loblolly cone maturity and on the phases of the longleaf seed-moisture content study dealing with overwinter storage, resistance of seed to heat, and behavior of seed following removal from cold storage. The last of the service germination tests for Region 8 were completed. A new study of the effect of light upon germination of seeds of various species and qualities was set up, and is showing striking initial results.

The overwinter storage test of longleaf pine seed at different moisture contents confirms and extends the results of the 1936-37 study. As is shown in table 1, initial moisture content alone is nearly as important a factor in storage as is the temperature of the storage environment, while container type is relatively unimportant. As shown in table 2, moisture content, in its interactions with container and temperature, has an even more conspicuous effect on keeping quality. Significances have not yet been determined.

Table 1

Average germination percentages of longleaf pine seeds after 3-1/2 months storage						
Storage environment	%	of seed, %	Germ.	Moisture content	Germ.	Germ.
Refrigerator at 38° F.	62.30	6.2	52.75	Friction-top tin	47.20	
Unheated shed	36.75	8.9	50.33	Cheesecloth sack	46.00	
Heated office	32.45	12.0	46.75	Sealed glass, with charcoal	42.87	
- -	-	15.1	38.92	Sealed glass, without charcoal	39.27	
- -	-	18.9	30.42	- -	-	

Table 2

Container	Storage environment, including temperature	of seed with initial moisture content	Final germination percentage, after 3½ months storage, of longleaf pine seed with initial moisture content
Friction-top tin, without charcoal	Refrigerator at 38° F	65	6.2% : 8.9% : 12.0% : 15.1% : 18.9%
	Unheated, open shed	46	
	Steam-heated office	48	
Cheesecloth sack, without charcoal	Refrigerator at 38° F	61	68
	Unheated, open shed	39	64
	Steam-heated office	40	55
Sealed glass jar, with charcoal	Refrigerator at 38° F	59	23
	Unheated, open shed	49	31
	Steam-heated office	49	
Sealed glass jar, without charcoal	Refrigerator at 38° F	59	6.2% : 35
	Unheated, open shed	49	33
	Steam-heated office	40	

Southern

Puerto Rican Regeneration Project. On April 1, L. R. Holdridge, who had been in charge of planting on the Caribbean National Forest, was transferred to the Southern Station to work on seed, nursery, and planting problems directly affecting the C.C.C. Camp Program in Puerto Rico. Wakeley spent April and half of May on a trip to Puerto Rico to help Holdridge get the work under way. Material was gathered for a problem analysis, a tentative program of studies was set up, and work was started on a seed storage study and on a study of size-classes and top-pruning practice applied to Honduras mahogany.

The Puerto Rican C.C.C. Camps are spending approximately a million dollars a year on planting. The plantations are being established at elevations from sea level to more than 3,000 feet, on a great variety of sites, under rainfalls averaging from 20 to 180 inches or more a year, and with thirty to sixty species of trees. Many other species are to be tried. The two studies first undertaken are particularly important, because seed of some of the more desirable species remains viable for less than two weeks under ordinary conditions and cannot be sown at the most appropriate season, and because date of sowing, irregularities in germination and the vicissitudes of weather often result in large quantities of stock from 3 to 6 feet high or higher, although the size desired is 18 inches to 2 feet.

Southwestern

Rodent Damage: Douglas Fir. Results of experimental field planting of Douglas fir at the Cloudcroft branch station have again demonstrated the need for rodent control. Plantations established in the Spring of 1937 showed good initial survival but were mostly ruined during the past winter by gophers. The destructive work appears to be done chiefly after the ground becomes covered with a blanket of snow. The gophers then tunnel under the snow in search of food. Whole mountain sides were found to be literally covered with the remnants of surface runways. Some evidence of rabbit damage was also found.

Interesting exceptions to the above were obtained in selectively cut stands. Here rodent damage to plantings was practically absent and the trees came through the winter in good shape. Since the stands had just been recently cut, gophers had apparently not as yet found the areas to be sufficiently inviting.

Formation of pinon cones. Three growing seasons, rather than two, are required for the formation and maturing of cones of pinon (Pinus edulis).

Microscopic examination of prepared sections of pinon buds confirms the expectation, based upon similar studies by workers on other species of pines, that three seasons are involved. The minute beginnings or primordia of cones were found in dormant terminal buds collected in November 1937 and obviously were formed near the close of the growing season in the summer of 1937. The pistillate cones would

Southwestern (Cont'd.)

have emerged from the buds and would have been pollinated in the spring of 1938, would have been fertilized in the spring of 1939, and would have completed growth and matured seeds by September 1939.

Primordia of cones at the close of the first season's growth while enclosed within the scales of the terminal bud are less than 1 mm. in length, including base, and less than .5 mm. wide. After some practice one can recognize these primordia in the field by examining buds cut longitudinally with a razor blade or sharp knife. A hand lens of low magnification is sufficient.

Buds are composed almost entirely of primordia of spur branches, which bear the needles and which are similar to primordia of cones. However, primordia of cones may be distinguished by their larger size, their broader base, their position single or paired at the tip of the bud, and their color, which is white instead of green. Of course, a majority of buds are merely vegetative and without primordia of cones, and still other buds of larger size contain primordia of staminate cones.

Practical applications are obvious. The maximum number of cones that will mature in the fall of 1940, for example, will be determined before growth stops in the summer of 1938, but the number of cones maturing will be less due to mortality from various causes. Theoretically, it would be possible by examining buds to locate the trees and areas producing cones and to predict roughly the yields of nuts more than two years in advance. However, it is doubtful whether tedious examination of buds at this early stage would be necessary or practicable, as the cones emerge from the buds the following spring and may be counted more readily then.

Any experimental treatment applied to pinon trees in an attempt to increase production of cones thus would not show its effects in seed production until at least three years later. Study of factors affecting crops of pinon nuts becomes complicated because of the long period involved and the various changes in weather conditions and internal factors of nutrition of the trees during this interval. If the large pinon crops which occur irregularly in different areas are correlated with local weather conditions, weather conditions must be favorable over a period of three successive seasons. The first season must be suitable for production of large numbers of primordia of cones, and the second and third seasons must be favorable for growth and maturity of cones and seeds.

FIRE PROTECTION

Appalachian

Fire Danger. The importance of season of year as a variable factor in fire danger and the relation of the sun's position to fuel moisture changes is being investigated at the Bent Creek Experimental Forest by means of an "artificial sun." This device consists essen-

Appalachian (cont'd.)

tially of heating elements controlled to produce radiation equal to that of the sun shining on slopes of any degree of steepness or aspect at any season of the year or hour of the day. Control of air movement permits additional investigations of effect of wind on rate of drying of fuels and their moisture equilibria when complicated by solar radiation.

A great deal of theoretical work and computations on the part of Byram preceded initiation of two of these tests in the field. Preliminary work of last summer indicates that some exceptionally interesting results may be expected from this study.

California

Fire-Danger Rating. Recent developments in the fire-danger rating project have included revision of the spread, ignition, and lightning indexes and the establishment of the fire organization classes. The ignition index is determined from a curve of the relative probability of fire starting at various fuel moisture values on the basis of data gathered in the first season of fire danger rating work. The spread index is based upon the studies of rate of spread on the Shasta Experimental Forest. Two independent variables, fuel moisture and wind velocity, are used in determining this index. The lightning index, revised by Gray of the Weather Bureau, is in the form of a graph which utilizes cloud base elevation, average ground elevation, and forecasted data on extent, severity, and precipitation of the storm. A method is provided for converting the lightning index into probable number of fires per unit area.

Seven classes of organization are recognized from Class 1, no fire danger, to Class 7, full emergency, agreeing closely with the organization classes used in both Regions 1 and 6. The class of organization is determined by the multiplication of the spread and ignition indexes on the theory that the number of fire control positions justified is a function of the product of the number of fires liable to occur and their probable rate of spread.

Chemical Control of Vegetation. Several extensive firebreak treatments have been recently established in firebreaks on the Cleveland, Angeles and San Bernardino Forests to serve as demonstration areas in soil sterilization. The treatment consisted in most cases in the application of white arsenic, As_2O_3 , to a center 5-foot strip at the rate of 4 pounds per square rod. The arsenic applicator described in the monthly report for December 1937 (p. 21) was used successfully to treat several miles of such strip. In addition to the firebreak demonstrations several miles of roadside strip were similarly treated.

Instructions on methods of soil sterilization have recently been prepared for the guidance of forest officers in the treatment of

California (cont'd.)

firebreaks, fire lanes around campgrounds, fag stations, and similar areas now requiring annual maintenance for fire prevention. This will be issued as a mimeographed circular.

Recent modifications in refining practice have increased the gravity of Diesel oil from 27° A.P.I. to approximately 32° A.P.I. This change resulted in a marked reduction in efficiency of the oil as a toxic agent. To determine if any of the petroleum oils in commercial use are suitable for our purposes, stumps were treated in 1937 with 24° A.P.I. oil and with a mixture of 24° A.P.I. and 32° A.P.I. oil. A recent examination of the treated stumps proved disappointing in that less than 50 percent of the stumps treated were killed. At the present time we can recommend two substances only for stump killing, sodium arsenite and sodium chlorate. The former is dangerous because of its attractiveness to grazing animals while the use of the latter sometimes results in spontaneous combustion. Experiments are being continued in stump killing to determine the effectiveness of certain other petroleum derivatives.

Northern Rocky Mountain

Fire Danger Meter. The revised Northern Rocky Mountain fire danger meter, Model 5, was distributed in late May to all Forest officers in Region One and to other stations, regions, forest schools, Glacier and Yellowstone Parks, and some other forest protective agencies. Applied Forestry Note No. 85 describing the new meter was issued at the same time.

Widespread interest in the danger meter method has been shown by the requests received from recipients of Applied Forestry Note No. 85, who did not receive meters. These requests include (1) National Fire Protection Association, Boston; (2) Regional Foresters of Regions Three and Five; (3) National Park Service, Chief Forester; (4) two Indian Agencies; (5) three Weather Bureau offices; (6) Soil Conservation Service; (7) Forest Service of British Columbia; (8) a logging and lumber company in New Brunswick; (9) several forest schools; and (10) one timber protective association. These, and additional local requests, are being filled as rapidly as the new meters can be cut out and assembled.

Multilithing 1,000 copies of the new meter cost \$18, or 1.8 cents each. Cutting out the windows and taping the sides costs 10 to 15 cents per meter by using Junior Assistant to Technician labor. Some 600 copies were needed to supply agencies now using the Region One methods. The supply of 400 additional meters is expected to meet replacement and new demands for about two years. Forest schools requesting 100 or more copies have, in the past, been furnished merely with the printed uncut cards, the cutting and taping being done by students.

Fire Studies. At Priest River all routine fire projects are being carried by Hayes with the help of two Junior Assistants to Technician, and two field assistants hired locally. Two technically trained

Northern Rocky Mountain (cont'd.)

field assistants will replace the two local men early in June. Lack of funds apparently will result in dropping the chemical studies of vegetative condition, carried for the last three summers by a professor of chemistry hired as a field assistant for three months each summer.

Gisborne is making a special effort this year to make the fire danger measurements on the seven eastern Montana Forests reach the standards of accuracy and representative sampling demanded on the ten western Forests. This requires personal inspection on each of the seven eastern Forests, the selection and installation of some new stations, and the relocation of some old ones. The Regional Office has announced that this year all Region One Forests will determine the size of the fire control organization currently on the basis of fire danger measurements. As this is the final step in the adoption and field use of our fire danger measurement principle the Station is making an exceptional effort to help.

Pacific Northwest

Fire Control Replanning. Morris and his assistants completed the major features of the sample ranger district plan for the fire control replanning project, and this sample plan and the principles and procedures involved in its making are now being reviewed in conferences with the Regional Office. If this procedure of making the fire control plans is finally approved by the Regional Office it is expected that this sample plan will be used as a guide by the forests in making their plans for each ranger district.

Fuel Type Mapping. Matthews and Morris attended the region's fuel type mapping school at Wind River and helped to prepare some of the instructional devices used at the school and reviewed the specifications of the field work. Talks on fire research subjects were delivered before the protection classes at the University of Washington by Morris and at Oregon's forest school by Matthews and Wilkinson.

Fire Danger Rating. Wilkinson prepared sample district ranger and supervisor's strength of force plans to be used with the fire danger rating system. He also completed several follow-up jobs necessary in order that the fire danger stations, fire danger boards, and the fire danger rating system in general may be used to the best advantage by all interested agencies. Several additional fire danger boards were made and distributed.

FOREST GENETICS

California.

Physiology. Several crossed (and wind-pollinated) conelets of Pinus echinata were subjected to heat treatments for the purpose of doubling the chromosome number during the first divisions following

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California (cont'd.)

fertilization and thereby obtaining allotetraploids - fertile, true-breeding hybrids that are in effect new species.

The treatments were applied with a portable apparatus designed for use on other plants by P. C. Burrell, Research Assistant in Botany at the University of California, which may be of interest to other Stations. In addition to being portable, the apparatus is simple and inexpensive. That it can be adapted for use on most species of pine and numerous other tree-species seems very probable. The heating chamber consists of a glass cylinder - it should be of some other light, insulating material - into which is fitted a coil of three-millimeter copper tubing. One end of the cylinder is closed with a rubber stopper that has two holes - one for a thermometer, the other for one end of the copper tube, to which is attached a short piece of rubber tubing leading to a thermos jug. The conelet is inserted into the other end of the cylinder and the opening is closed with a cotton plug. The other end of the copper tubing projects outside and below the cotton plug. The desired temperature is obtained and held by siphoning water of the proper temperature from the thermos jug through the copper coil. The rate of flow through this system can be regulated so that the desired temperature can be maintained for about an hour with a gallon of water. Hot or cold water can be poured into the thermos jug as desired.

It is thought by many that the desired effect is produced not simply by increasing the temperature of the tissue gradually to the limit of its endurance but rather by subjecting it to a sudden change from a very low to a very high temperature. We used two jugs - one filled with ice, salt and water and the other with hot water from the tap. Water was siphoned first from the cold water jug and temperatures of from 40°F., to 45°F., were obtained and held for about 25 minutes. Then the tube was transferred to the hot-water jug for the heat treatment. By this means a change of 55°F., was obtained in two minutes and a change of 65°F., in five minutes. Various treatments were given, one of which, a treatment of 121°F., proved lethal.

Whether or not the treatments were applied at the proper time is unknown. Only empirical knowledge respecting the time of fertilization was available as a guide. A precise determination of this vital factor is a cytological problem that is already under study by Dr. Stockwell. Ordinary cytological methods will doubtless suffice for treatment of conelets that have not been crossed. For crosses, a very rapid method of determining the time of fertilization may be required. Possibly freezing the tissue on the microtome may serve the purpose.

RANGE INVESTIGATIONS GRAZING MANAGEMENT

Southwestern.

Shrub invasion control: Burroweed. During the middle of May, 50

Southwestern (cont'd.)

small experimental plots (1/50 acre) were subjected to 25 different treatments. These treatments consisted of such eradication methods as burning, grubbing, mowing, and the application of chemical sprays such as kerosene, stove oil, Diesel oil (27° API) and various aqueous concentrations of Atlacide, sodium chlorate, and sulphuric acid. Various heterogeneous mixtures of Colemanite ore and sodium chlorate were applied in dry powdered form to the stem bases of the burroweed plants.

Burroweed counts were made on 64 demonstrational (0.1 acre) plots. The plants were segregated into two broad classes consisting of plants above and below 6 inches in height. Thirty-two of the plots located at Station No. 130 (on the Santa Rita Experimental Range) contained an average number of 874 per plot, of which 579 were above 6 inches and 295 were below this height. The maximum number of burroweeds found per plot in this area was 1,785 and the minimum was 398. Perennial grass density on 14 plots, as determined by the use of the single dimensional line transect (528 lineal feet per plot) was 1.95 percent of the ground surface; burroweed density was 6.31 percent.

At Station No. 131 burroweed counts on 32, 0.1-acre plots averaged 1,864 per plot with 994 per plot above 6 inches and 870 per plot below 6 inches. The maximum number per plot was 2,960 (or 29,600 per acre). The minimum number was 1,417 per plot. Perennial grass density on 20 plots averaged 0.43 percent; burroweed density was 7.38 percent.

Snakeweed. Similar preliminary data and photographs prior to treatment are also being secured on the snakeweed plots at the Jornada. Snakeweed counts have been made on 64 out of a total of 96 demonstrational 0.1-acre plots (which will receive eight different treatments under four intensities of grazing). In one area 32 plots had an average number of 313 individual plants per plot, of which 234 were above 6 inches and 79 below this height. The plot with the maximum number contained 426 plants (4,260 per acre), whereas the plot with minimum number had 187 individual plants. In the second area 32 plots contained an average per plot of 359, of which 295 were above 6 inches and 64 were below this height. The plot with the maximum number had 486 and the plot with the minimum number of individual plants had 165.

RANGE INVESTIGATIONS RANGE FORAGE

California

Foothill Ranges. In last year's annual report it was pointed out that a surprisingly great number of plants may be found on small

California (cont'd.)

sample units in the annual-plant cover type. Soon after the rains start in the fall a heavy stand of seedlings appears. The maximum number that may occur on a given unit is dependent to a large extent on the type of plant; such small plants as the annual fescues (*Festuca* spp.) are in numbers several times as high as those of large cotyledonous plants, for example, filarees (*Erodium* spp.).

Last fall several sods of four different species were selected for additional seedling counts. At the same time a plot of similar density close by was staked for counts at plant maturity. In all cases the sods were chosen in areas of relatively high density. Estimates were made of density of the seedling plots, and when growth ceased on the mature plots. In most cases the density increased on the plots from the seedling stage to plant maturity. The individual plots were taken in almost pure stands of a given species, and all other plants occurring on the plots were counted and grouped as "others". The results of the counts are shown in the following table:

Species	Plants			Other Plants		
	Plot density	per sq. ft.	per sq. ft.	Mature	Mature	Mature
	Seedlings	Plants	Seedlings	Plants	Seedlings	Plants
<i>Erodium botrys</i>	76	77	1,210	1,002	1,032	1,002
<i>Bromus mollis</i>	58	77	8,638	5,075	438	525
<i>Festuca megalura</i>	60	74	15,625	7,435	332	395
<i>Trifolium variegatum</i>	55	79	6,650	381	2,462	231

The clover plants showed the biggest drop from the seedling stage to plant maturity. Plots of the other species showed a considerable drop, but even so the number remained very high.

A few counts made last year of plants taken from very high density areas showed the number of seedlings to be about 30 percent higher than the average on these plots. On the range as a whole, averages would be expected to show fewer plants per square foot than the maxima; but, on the other hand, decrease in numbers of plants, from the seedling stage through plant maturity, would be less on the average than in the plots of maximum density, because competition would be somewhat reduced.

Pacific Northwest

Sampling Forage Types. On a high mountain range on the Whitman National Forest which contained three main types in varying amounts, a study was made to determine the number of plots necessary to sample the vegetation within a reasonable limit of error when employing the point-observation method of estimating density and grazing capacity. The types on the area consisted of wet meadows and subalpine needlegrass (Stipa columbiana) -fleeceflower (Aconogonum phytolaccacefolium) and sedge (Carex sp.)-big sagebrush (Artemesia tridentata) types. To sample the grazing capacity of all the areas as expressed by the forage-acre factor closer than to a 10 percent variation from the mean (probability of greater variation being 5 percent) would have required an excessive number of plots. To sample to a 10 percent with a 5 percent probability of greater variation would have required 471 plots. On one area studied where it would have required 506 plots to have sampled to a 10 percent error, the number of plots could have been materially reduced by sampling a 3- or 4-acre meadow separately. Thus the area, exclusive of the meadow, could have been sampled to the same degree using 156 plots. The meadow in this case would have justified close sampling because, while covering only $1\frac{1}{2}$ percent of the area, it contained 12.6 percent of the feed produced by the entire unit of 226 acres. By dividing the unit into its three types and sampling each type separately, to sample to the limits previously stated would have required 269 and 144 plots for subalpine needlegrass-fleeceflower and the big sagebrush-sedge types, respectively, or a total of 413 plots--an increase of 157 plots for the unit exclusive of the meadow. This indicates that when determining grazing capacity of a block of range having large distinct forage types it may be desirable to compile plots within type boundaries, but when types are small and somewhat similar as to grazing capacity, accuracy may be increased by eliminating type boundaries and compiling to unit. This would eliminate error incurred when drawing type boundaries and yet give adequate sampling for the whole unit.

Southwestern

Herbarium. The University of Arizona and the Southwestern have recently completed cooperative work in assembling and mounting nearly 500 herbarium specimens of the more important southwestern range plants. The work has been under the personal direction of Dr. D. M. Crooks, head of the botany department of the University.

Altogether, 232 species in 172 genera have been mounted in duplicate, one for each agency. These are divided into grasses, 36 genera and 66 species; weeds, 64 genera and 72 species; and browses 72 genera and 94 species. Of this number, the station is exhibiting 114 of the most important species in wall racks in its visitors' waiting room. This exhibit includes 29 genera and 50 species of grasses, 22 genera and 23 species of weeds, and 39 genera and 41 species of browses. (The mounts comprise a backing of cotton on masonite prestwood covered by the heaviest cellophane available and bound by Scotch tape.)

FOREST PRODUCTS

TIMBER HARVESTING AND CONVERSION

California

Logging and Milling Studies (McCloud) The McCloud study was designed principally to determine the true values of small-size ponderosa pine trees, the sample consisting of 80 trees between 13 and 30 inches d.b.h., and 20 trees over 30 inches. The identity of the lumber from each log and tree was retained to the final surfaced shipping grades. An analysis of the variance of tree values per M B.M. surfaced tally has been made recently to test the significance of value differences between tree classes (Dunning) and to design a study sample for the current field season. The means, standard errors of the means, standard deviations, and the standard deviation of the standard deviations calculated for each class within the three 6-inch diameter groups below 30 inches are as follows:

D.B.H. group inches	Dunning's tree class	Trees number	Statistics of tree values	
			Mean Value	Standard Deviation
13-18	2	11	\$20.88 \pm 0.70	\$2.31 \pm 0.49
	6	15	20.27 \pm 0.51	1.96 \pm 0.36
	All classes	26	20.52 \pm 0.38	1.92 \pm 0.27
19-24	1	6	19.76 \pm 0.82	2.00 \pm 0.58
	2	15	20.33 \pm 0.28	1.09 \pm 0.20
	3	1	24.75 -	- -
	4	10	22.19 \pm 0.67	2.12 \pm 0.47
	All classes	32	20.94 \pm 0.36	1.99 \pm 0.25
25-30	1	6	20.41 \pm 0.46	1.13 \pm 0.33
	2	2	22.96 \pm 1.56	2.21 \pm 1.11
	3	9	21.83 \pm 0.80	2.40 \pm 0.57
	4	3	23.90 \pm 0.86	1.49 \pm 0.61
	All classes	20	21.83 \pm 0.44	1.97 \pm 0.31

The 20 trees above 30 inches were chosen to determine points of special interest, and are omitted from the tabulation because they are not representative of the stand as a whole.

California (cont'd.)

By tree classes and D.B.H. groups, the following pairs of values exhibited significant differences:

D.B.H. group	: Comparison	: Values	: DF ^o	: t
19" - 24"	: Class 1 to Class 4: \$19.76 - \$22.19:	14	:	2.25
	: : :	:	:	:
	: Class 2 to Class 4: \$20.33 - \$22.19:	23	:	2.85
	: : :	:	:	:
25" - 29"	: Class 1 to Class 4: \$20.41 - \$23.90 :	7	:	3.18
	: : :	:	:	:

^o Degrees of freedom.

The formulae employed in this test are explained in "Statistical Methods for Research Workers", Sixth Edition, pages 128-129, By R. A. Fisher.

For a first trial in designing a study sample from these data, it seems desirable to determine the group means within \$1.00 per M.B.M. in such a way that 19 out of 20 random samples will fall within this range of the true value. Therefore, the value of the standard error of the mean may be taken as $\pm \$0.50$ per M.B.M., which gives 16 trees per 6-inch class 2.7 trees per 1-inch class in sizes 30 inches d.b.h. and smaller. For trees 31 inches and over, the standard error of the group means will increase, - ranging between \$0.67 and \$0.98 in the present case, - but to avoid an unwieldly sample, it is believed that an average of 2 to 2.5 trees per 1-inch class will give a standard of accuracy sufficient for rough estimates.

Northern Rocky Mountain

Power Saw Development. A Dolmar chain saw powered by a $5\frac{1}{2}$ H.P. gasoline motor has been obtained by Equipment Engineer George Duncan from the Vulcan Iron Works of Denver for demonstration purposes. Preliminary tests have indicated that this saw has some possibilities for bucking at the landing but its weight of 96 pounds compared to the Region One modified Wolfe saw weight of 85 pounds makes its value doubtful for felling timber. Arrangements have been made by the Division of Products for determining the value of this saw for bucking at the landing at the E. A. Findell Lumber Company.

Pacific Northwest

Pine Mill Studies. A time study was completed at the Buzard-Burkhart pine Co., a mill cutting about 60M per day. Early in June a log analysis will be made there, to provide another sample in mills cutting heavily to box.

At the request of the Underwood Lumber Co. a special study was made at that mill. Sherman Feiss, of the Fremont National Forest office, scaled and graded logs on the deck and Lodewick conducted a time study on the same logs. The company kept a record of lumber production by grades, and will be provided with an analysis of the log grades sawed and of the milling time and costs.

Computation of data for the Flagstaff, Arizona, study has been completed and pond margins for sound logs and logs of various scaled defect percentages have been obtained. This study was carried out at the McNary mill in cooperation with the Southwestern Station.

FOREST PRODUCTS STATISTICS

Northern Rocky Mountain

Lumber Census The 1937 canvass of production is completed with the exception of a small amount of follow-up work required to correct a few schedules returned by the Bureau of the Census. A news release covering the 1937 production will be sent to the Chief for approval by the Census Bureau by June 15. Based on experience in conducting the 1937 canvass, as well as the census for previous years, the time limit for completion of the biennial census has been set for June 15 while it is figured that the small census can be completed each year by May 15.

Pacific Northwest.

Lumber Census. To date 1,852 acceptable schedules have been forwarded to Washington. Johnson expects to spend the next three weeks in the field "mopping up" those companies from whom no replies have been received.

Log Depletion. Completion of log depletion data for western Oregon and western Washington for all years previous to 1937 is nearing completion.

WOOD PRESERVATION

Northern Rocky Mountain

Wood Preservation For the past four years, Whitney has accompanied railroad officials on their annual inspections of cotton-

Northern Rocky Mountain (cont'd).

wood test ties near Lolo, Montana, in the Bitterroot Branch of the Northern Pacific Railway. The original installation record shows that a total of 261 "Montana Cottonwood" ties were placed in this track in March 1910. The ties were air-seasoned, not bored, adzed, nor incised, and were treated by the Lowry Process with 6-3/4 pounds of 80-20 creosote-coal tar solution. These ties were originally laid with dirt ballast and 56-pound rail without tie plates. In 1918, after being without plates for eight years, the ties were equipped with 6-1/2"x8" plates, and in 1923 the track was relaid with 85-pound rail.

At the 1937 inspection, 210 or 80.4 percent of these test ties were still in service. Sixty-five percent were classed as being in good condition. Only 27 or 12.8 percent of the original ties in the track were judged as likely to require renewal within the next three years. Prior to 1936 only 35 ties had been replaced. In 1936 there were 16 replacements, but during 1937 no renewals were needed. With only 51 new ties laid, or 19.54 percent renewals in 27 years of service, the Forest Products Laboratory's "Renewal Curve" indicates that only 70 percent of the average life of these ties has been realized. Officials of the railway company estimate that on the average, treated ties should give about 60 percent longer life in this branch line than in main line track.

FOREST SURVEY

Appalachian

Inventory. Plans have been completed for continuing the survey in the mountain unit of western North Carolina during the coming summer.

Girard spent three weeks in western North Carolina during May collecting field data for volume table construction. Data were recorded for approximately 6,000 trees involving 24 species or specie groups. Both the Pisgah and Nantahala Forests cooperated by detailing staff members to work several days with Girard and Davis.

The basic tables of area and volume have been completed for the two coastal plains units of North Carolina so that figures are now available for all of the State east of the mountains (80 percent of the State area). The sawtimber volume by units is shown in the following table:

Net volume in millions of board feet
International 1/4-inch rule

<u>Unit</u>	<u>Pine</u>	<u>Hardwoods</u>	<u>White Cedar and Cypress</u>	<u>Total</u>
N.C. No. 1 (Southeast)	8,453	3,341	467	12,261
N.C. No. 2 (Northeast)	9,141	4,241	954	14,336
N.C. No. 3 (Piedmont)	7,674	3,410	--	11,084
	25,268	10,992	1,421	37,681

Depletion. Depletion field work has been completed in 22 of the 100 counties in the state. Over 1,000 sawmills were found in these counties alone in contrast to the state total of 840 mills reported by the Census for the preceding year. The difference is due chiefly to the large number of small mills which do not report to the Census. A cooperative agreement is being worked out with the Bureau of the Census to affect an interchange of data with the survey which should greatly reduce the duplication of work and improve the production records of both agencies.

Growth. Growth computations have been completed for South Carolina unit No. 2 and balance sheet showing the comparison of increment and depletion has been prepared. The following table gives the balance for the unit expressed in cords:

Appalachian (Cont'd.)

Balance between increment and depletion
South Carolina unit no. 2.

	<u>Pines</u>	<u>Hardwoods</u>	<u>Total</u>
		<u>Cords</u>	
Net growing stock, Jan. 1, 1936	27,641,400	28,200,800	55,842,200
Growth 1936	1,556,300	1,093,800	2,650,100
Mortality 1936	231,500	356,000	587,500
Forest increment 1936	1,324,800	737,800	2,062,600
Forest depletion 1936	1,249,100	695,400	1,944,500
Net change in growing stock 1936	+75,700	+42,400	+118,100
Net growing stock, Jan. 1, 1937	27,717,100	28,243,200	55,960,300

Northern Rocky Mountain

The Nez Perce County inventory report was released May 23, as the tenth of the regional series. The report for Lewis County is being mimeographed and the rough draft has been completed for Clearwater County. A history of the lumbering industry in northern Idaho has also been completed.

The type and volume data have been summarized for Idaho County and inventory statistics are now available for all of northern Idaho.

The inventory statistics show a total timber volume of 40.5 billion board feet in sawtimber stands of northern Idaho. The western white pine volume in sawtimber stands is 9.8 billion board feet, or 24 percent of the total. Of these totals 37.4 billion feet of all species is in availability Zones I and II. Practically all of the white pine volume is in availability Zones I and II.

Pacific Northwest

... Douglas Fir Region Inventory Results. At the time of the original survey of Grays Harbor County, March 1, 1933, there was 50 thousand acres of type 35, areas cut prior to 1920 and not restocked. In 1937 more than 43 thousand acres of this area remained nonrestocked. Between 1920 and 1930 approximately 113 thousand acres of nonrestocked cut-over land was added to this figure, making a total of 156 thousand acres of such land in the county as of 1937.

Pacific Northwest (Cont'd.)

Ponderosa Pine Region Growth Phase Results. The following table summarizes current gross growth in the virgin types:

Preliminary Summary of Current Annual Gross Growth in Virgin Types

Current annual gross growth in--			
Eastern Oregon	Virgin types	Total	
	ponderosa	other than virgin forest	
	pine types	ponderosa pine types	
	:Million bd. ft.	:Million bd. ft.	:Million bd. ft.
Eastern Oregon	477	110	587
Eastern Washington ¹	154	149	303
Total	631	259	890

1/ Exclusive of Stevens, Spokane, and Pend Oreille Counties.

Southern

General. Eldredge and Cruikshank completed a field trip begun in April with R. F. Hammatt (assistant to Chief Forester, Silcox) and C. F. Evans, Assistant Regional Forester. Later, in Jackson, Mississippi, Eldredge attended a brief meeting of the Advisory Committee to the National Resources Board.

Release. A release, "Forest Resources of the Ouachita Mountain Region of Arkansas" by Cruikshank, will be sent out soon. This report, covers an area of about 5 million acres extending from Little Rock to the Arkansas-Oklahoma boundary line. The most unusual feature of this Unit is that the Forest Service owns about 1-1/4 million acres, or about one-third of the total forest land area of 3-1/3 million acres.

Shortleaf pine is the predominant species, although white oak, red oak, hickory, red gum, and ash are also important. Less than one-fourth of the forest is old growth the remainder being under-sawlog-size second growth. In analyzing the present forest situation, Cruikshank says "It is deficient in stocking; the areas in the five age-classes between 21 and 70 years closely approximate those of a managed forest.....; the distribution of age-classes by area is deficient, in that the area in the youngest age-classes is only one-twelfth of what it should be, while the area in the 80-year-and-over age-class is much greater than is needed. The opportunity for increasing the forest crop is good..... the present average stand contains only 55 percent of the volume of a managed stand, indicating that through management the increment could be nearly doubled. This can be attained, only by the continuous and concentrated effort of private owners, and public agencies."

FOREST ECONOMICS

NEW PUBLIC DOMAIN

Lake States

Tax Delinquent-Land Inquiry. Mr. Zon plans to accompany the Interim Committee of the Minnesota Legislature when it holds its hearings in northern Minnesota during the latter part of June. The chief items of inquiry are how to handle the large acreage of tax delinquent land which is reverting to the state this year and how to compensate the counties for lost tax revenue.

Pacific Northwest

Taxation. Several conferences were held with members of the Station and Regional Office staff in regard to the Wohlenberg income tax proposals with particular reference to properties where light selective logging might be practiced.

In Tillamook County, Oregon, the taxation and local government reorganization studies were continued. The total assessed valuation of this county has been reduced from \$28,923,265 in 1927 to \$12,515,025 in 1937, or a reduction of 57 percent, due chiefly to the reduction in timber values because of cutting, the great fire of 1933, and forfeiture for nonpayment of taxes. During this 10-year period the State and county tax rates applicable to these assessed values increased from 24 mills to 31 mills, which means a reduction in these tax levies from \$702,835 to \$390,469 or a reduction of 44 percent, with no important increase in revenues to the county from other sources. However, part of the timbered area is included in special districts subject to various additional tax rates up to 37 mills in 1927 and 46 mills in 1937, making maximum tax rates on timber of 61 mills in 1927 and 77 mills in 1937, both levied on assessed values reputed to be from 50 to 75 percent of true value.

Planning. Cooperation continued with Regional and State Planning Commissions and with Bureau of Agricultural Economics. Wilson collaborated with the Regional Commission in preparing the report entitled "Recent Migration into the Pacific Northwest", mimeographed and published in May. The forthcoming report on a suggested land use plan for Josephine County, Oregon, was critically reviewed with the author.

After more than one year of work, the Public Acquisition of Lands Committee of the Portland Chamber of Commerce, of which Wilson of the Station and Brundage of the Regional Office are members, reported (1) that present land acquisition action-programs by the Federal Government presented no serious tax problems in Oregon but as soon as Federal studies of contributions in lieu of taxes were published the

Pacific Northwest (cont'd)

committee should examine their application to Oregon conditions; and (2) that acquisition of forest and range lands by the counties for unpaid taxes presented tax, land disposal, and land management problems of such serious import as to warrant continued study and program development by the chamber in cooperation with the U. S. Forest Service, the State Tax Commission, the State Forester, the counties, and other agencies.

PRIVATE FORESTRY

Lake States

Farm Woodlot Study. Duerr commenced work on a new farm woodlot project in Carver County, Minnesota, in May. Three men are making intensive studies of sample farmwoods in an area just west of Minneapolis. Good use is being made of air photos obtained from the A.A.A.

Pacific Northwest

Selective Timber Management in Ponderosa Pine. Work was started early in the month on the tree valuation phase of the Rock Top Unit cooperative study following the completion of the mill study phase by the Division of Forest Products. This is a major case study of selective timber management in which this station is cooperating with the consulting firm of Mason and Bruce. Some rather complicated problems have arisen in this study both in the mill study and in the woods study phase owing to the prevalence of defect in the timber involved.

Selective Timber Management in Douglas Fir. At the request of Messrs. Wohlenberg and Plumb of the Division of State and Private Forestry, Brandstrom attended several meetings to discuss Wohlenberg's plan for treatment of depletion charges under existing and proposed income tax laws as applicable under a planned system of selective logging. One of these meetings was with the West Fork Logging Company. Operators in this region appear to be keenly interested, particularly in the tax adjustments now possible under existing income laws, according to which recognition can be given to the higher values liquidated under selective logging, whether it be tree selection or group or area selection.

At the request of the forestry department of the Weyerhaeuser Timber Company Brandstrom spent one day at their Tacoma office and one day in the field to help work out a plan of selective logging for a tract of Weyerhaeuser timber near Mineral, Washington. The tract embraces 1,500 acres with a stand of about 75 million feet, mostly large old-growth Douglas fir but with a fair representation of other species, sizes, and ages. This area is traversed by two public highways, one of which has heavy tourist travel during the

Pacific Northwest (cont'd).

summer season. It is the plan of the Weyerhaeuser Timber Company to liquidate most of the values found on this area without despoiling the roadside scenery of this magnificent stand and, incidentally, to use this area as an experimental forest to test and develop methods of selective logging in Douglas fir.

FOREST AND RANGE INFLUENCES

WATER BEHAVIOR AND RUN-OFF

Appalachian

Hydrological Data Manual. During the past five years the Forest Influences Division of the Station has been making measurements of stream discharge and precipitation recharge on small drainage areas, ranging in size from five to five thousand acres. These measurements provide basic data for studying the hydrology of small drainage areas in relation to land-use practices. Various methods of recording and compiling data were investigated and a uniform procedure for the use of forms in routine computations was developed. The most practical methods and procedures evolved by this Station are presented in the manual.

To illustrate the use of the forms, data obtained from an actual storm on a well forested drainage area have been compiled and the computations carried out on each form.

The manual was prepared by L. K. Hill, Associate Civil Engineer, and K. A. MacKichan, Junior Hydraulic Engineer, under the direction of C. R. Hursh.

California

San Dimas Experimental Forest. May was practically rainless, only 0.6 inches of precipitation occurring during several periods of foggy weather. This allowed increased attention to be given to repair of the damage caused by the March floods. Reservoirs 1 and 3 in Bell Canyon have been completely emptied and their fill material sampled. Clogged flumes have been reopened and good progress made in rebuilding roads washed out by the flood.

Six of the intermediate watersheds have been covered by a special photographic survey designed to picture clearly the vegetation types, erosion "sore spots", and topography. This has been satisfactorily accomplished by photographing individual watersheds under flat lighting, to show vegetation and soils, and again under side lighting to bring out the topography.

California (cont'd.)

The concrete for five root-study lysimeters was poured during the month. These tanks are 4 x 6 x 6 ft., with bottom and three walls of concrete, the fourth wall of redwood planks which can be removed to facilitate the study of plant roots growing in them.

New single-unit collector tanks have been designed for the run-off and erosion plots, to simplify this type of installation. This equipment will be tested at the plots in Fern Canyon, where freezing temperatures are apt to cause failure of tipping buckets that are now in use there.

Kings River Watershed Studies. Seasonal precipitation of 26 storms up to May 1 amounted to 41.57 inches, which was 21 percent greater than last year's total. In December 1937, an 80,000 sec. ft. flood occurred on the Kings River at Piedra, the highest measured since the beginning of records in 1895. Other great floods of history occurred in 1851-52, 1861-62, 1867-68, and 1871-72. The flood of 1867-68 was judged the greatest of all, estimated from high water marks and channel profiles at 95,000 sec. ft. Peaks of 59,700 sec. ft. and 45,400 sec. ft. were recorded in 1914 and 1916 respectively.

Mapping of cover types on the seven experimental watersheds has been completed by personnel from the Division of Range Management. The work included estimates of vegetation density, composition, and canopy cover, together with notes on degree of utilization by cattle for the entire area. All seven drainages were covered in a reconnaissance manner, while approximately 100 milacre quadrats were established in watershed No. 3, using the random block sampling method of location. From these quadrats will be determined the number of samples required to represent adequately the whole experimental area.

Watercycle and Soil Studies

North Fork. The current seasonal precipitation at North Fork has been the highest ever recorded since the beginning of the collection of rainfall data in 1904. The 60 inches of rainfall recorded for the season to date is approximately 28 inches above normal and about 8 inches above the highest previous record reported in 1910. Below the 3000-foot elevation the precipitation fell largely as rain, resulting in three major floods, two of which were the most severe in the memory of the present residents of the San Joaquin Valley, causing damages, totaling millions of dollars, to city property, agricultural lands, crops, roads, bridges, and power plants.

Analysis of data from 1/40-acre plots the past winter shows conclusively the effect of vegetation in reducing run-off and erosion.

California (cont'd.)

On the plots that have been burned annually, erosion occurred at the rate of 83 tons per acre, while total run-off amounted to $23\frac{1}{2}$ inches more than 39 percent of the precipitation. On plots twice burned, in 1930 and again in 1936, the erosion rate was 0.25 tons per acre and the run-off 2.25 inches, or 3.7 percent of the total precipitation. Undisturbed plots, on which the natural litter and plant cover was in its normal condition, yielded no erosion, while only 0.5 percent of the precipitation was lost as run-off.

Intermountain

Flume Structures Need More Slope. Combination converging section-trapezoidal flume structures, which have been installed on triplicate range watersheds at the Arrowrock Substation in Idaho, appear to have insufficient slope for self-cleaning purposes. Designed and constructed with a 3 percent slope on the floor of the converging section, the structures on these triplicate watersheds clog with sand and give distorted records of streamflow. No such difficulty has been encountered with comparable flume structures at the Wasatch Branch in Utah, presumably because of the higher gradient channels and greater velocity of flow. It is planned to increase the slope of the floor section of the flumes at the Arrowrock Substation from their present slope of 3 percent to 5 or 6 percent and recalibrate them.

SOIL STABILITY

Appalachian

Road bank fixation. The garden clubs of western North Carolina have been valuable assistants in the campaign for roadbank fixation. Hursh has addressed leading clubs at Tryon and Asheville and discussed the feasibility of beautifying the roadsides by covering the unsightly banks with appropriate vegetation. Many of the members of the Carolina clubs live on attractive country estates, have important contacts with local and state authorities, and are willing to take an active part in sponsoring road bank projects.

The Appalachian Station road bank project, begun in 1933, now furnishes examples of various methods for controlling erosion on road banks and fills. Honeysuckle, Scotch broom, roses, and other woody shrubs have been successfully used. These plantings have been visited by scores of interested persons, including project superintendents and highway engineers.

During the past year extensive road bank control has been experimentally practised on several miles of mountain road on the Ceweeta Experimental Forest. Various mechanical devices, particu-

arly wattles, and stake and log structures on banks steeper than 1-1 slopes are now being tried out.

Erosion Control. The effectiveness of vegetal cover in preventing erosion was demonstrated during the heavy March storm in southern California. In the denuded condition four years ago, paired 1/50-acre plots installed in the Pickens burn were severely eroded by a 3-inch rainstorm. The rate of erosion was calculated at approximately 19,000 cubic yards per square mile, direct conversion. The same plots yielded no debris in the 15-inch storm that produced the current March floods. An unusually dense cover of volunteer plant growth had completely stabilized the area.

Intermountain

Boise Erosion Demonstration Area. Extremely favorable climatic conditions to date have resulted in an excellent showing on the 320-acre demonstration drainage which was revegetated for erosion control purposes last fall. The difficulties of finding suitable species and of controlling Mormon crickets seems to be overcome at least, leaving the way open for further progress in the development of erosion control methods for this important area.

The tests show that winter rye is a desirable nurse crop and can be relied upon to provide satisfactory protection from erosion during the first year, providing the seed is drilled. On the experimental drainage it has made a height growth of 30 to 36 inches and is developing a heavy seed crop.

The most promising perennial species appear to be bulbous bluegrass (Poa bulbosa) and tall oatgrass (Arrhenatherum elatius), although all of several other species planted have made a good showing this year. While most perennials appear to grow very little in the first year after planting, Poa bulbosa has made a height growth of 12 to 18 inches and is seeding abundantly. The oatgrass has developed heights of from 6 to 12 inches. Other species are less than 5 inches high, but are growing vigorously.

Of the shrub cuttings used, native rose has made the best showing to date. Eighty percent of the plants have survived. Nursery stock of black locust suffered heavy winter killing and heaving, but it is expected that spring planting of this species will show up better in tests now being conducted.

Vigorous efforts by the Boise National Forest to control Mormon cricket infestation within the experimental area have been partially successful. ERA and CCC crews have reduced the numbers within the drainage to a point where they are no longer the controlling factor in the success of the artificial revegetation experiment. With all

Intermountain (cont'd)

available funds expended there are still enough crickets in the drainage to reduce the seed crop of rye and to seriously effect the development of other grasses. However, barring the migration of a feeding band into the area, at least practical control of the plague seems assured.

With artificially reseeded range areas showing good growth and with the cricket plague under control locally, it is definitely planned to continue with the erosion control tests on this experimental area. Two years ago the erosion potential of the depleted range was measured by means of the portable rain maker and absorption apparatus. These tests will now be repeated on the revegetated areas.

Plant Migration Approach to Revegetation for Erosion Control Purposes

The southern edge of the Idaho central mountain mass, which includes the Boise River watershed, projects like a rugged peninsula into the sea of lava and ancient lake beds that make up the Snake River desert. Partial isolation of this peninsula by the Malheur Desert on the west, the Snake River plains on the south, the broad, dry valleys of the Big and Little Lost River and the Upper Snake River on the east, and the high alpine height of the Sawtooth Mountains on the north may account for the absence of many plants on the Boise River foothill lands which flourish on nearby sites in the region. Conspicuously absent on the Boise, for example, are the scrub oak (Quercus gambelii), juniper (Juniperus scopulorum), skunk brush (Rhus trilobata), and mountain mahogany (Cercocarpus spp.).

Acting on this premise of isolation, tests have been initiated to determine the adaptability of these species to conditions at the Arrowrock Substation. Both juniper and Rhus have lived through one year in this locality and appear to be well suited to the conditions prevailing there. The two other species could not be reproduced vegetatively, but a number of oaks have been obtained from seed planted last fall and these seedlings appear quite vigorous to date. Further study of plants which may be well suited for erosion control and other purposes on the Boise River watershed appears to be warranted from these promising early results.

Lake States

Sand "Blows" on the Manistee National Forest. A frequent question asked the personnel of the Manistee is how to control the sand "blow" areas occurring in the northwestern part of the lower peninsula of Michigan.

Lake States (cont'd)

To better answer this question the largest and most spectacular "blow" area of approximately a thousand acres known as the Big Prairie which occurs within the Manistee National Forest was examined by the County Agent and members of the Forest Service representing the Forest, ~~Regional~~ Office, and the Lake States Forest Experiment Station.

The suggestion was made that first the area be mapped to show such areas as moving sand, level sand, grassland, and woods. Next a variety of tests be established including the planting of trees, shrubs and grasses, and the use of mechanical means such as brush, snow fence and lister furrows to determine the best methods of solving the problem before any large scale attempt is made to reclaim the area.

During the month a start was made on these tests by planting 2000 each of jack pine, red pine, white pine, pitch pine, black locust and black cherry, 1000 burr oak, 500 each of red oak and white ash, and approximately 50 each of Chinese elm and two species of populus cuttings. In addition, lilac cuttings were planted on three strips 10 chains long and quack grass rhizomes in several 10-chain furrows. The entire planting covered 10 acres, of which half was treated with windrows of brush placed about one chain apart in a north-south direction. Marked stakes were located in the area to measure any fluctuation in soil level.

FLOOD CONTROL SURVEYS

Lake States

Root, Little Cannon, Whitewater, Zumbro and Gilmore Creek. Public hearings have been held by the Army Engineers and the Department of Agriculture on five of the streams in the unglaciated area of southeastern Minnesota. The watersheds are the Root, Little Cannon, Whitewater, Zumbro and Gilmore Creek on which considerable flood damage has occurred, mostly as a result of the silt and debris carried by the flood waters. Preparation of preliminary reports is in progress on several of these streams and on two in Wisconsin.

The excessive rainfall during May has focused attention on local flood damage. The Mississippi has been very high with many of its tributaries overflowing their banks several times during the month. Although damage was considerable, the situation might have been much worse but for the fairly even distribution of the rainfall.

COOPERATING BUREAU PROJECTS

ENTOMOLOGY

(In cooperation with the Bureau of Entomology and Plant Quarantine)

Appalachian

Insect damage to red cedar seedlings. Serious destruction of red cedar seedlings at the Farm Security Administration Nursery near Lebanon, Tennessee, in 1937, has now been determined as caused by a dipterous insect. Present indications are that the insects are not attracted to the seedlings but that the damage is incidental to maggot activity in the fertilized beds. Laboratory rearing studies and field test plots are being continued.

White Grubs. Control of white grubs with carbon disulphide was suggested at the State Nursery near Georgetown, S. C., where unusually early damage has occurred.

Southern pine beetles. Heavy losses of loblolly pine by the southern pine beetle in eastern Virginia and northeastern North Carolina, were investigated. While much of the damage occurred during the summer and later fall of 1937, there is a strong probability that because of the current deficiency in rainfall and the apparent presence of numerous brood trees, serious infestation will occur this summer. No reports have been received of bark beetle outbreaks in the piedmont and mountain regions of the Southeast.

Southern

Lyctus Powder-post Beetles. A series of new tests on methods of treating lumber to reduce losses from powder-post beetles were started.

FOREST PATHOLOGY

(In cooperation with the Bureau of Plant Industry)

Appalachian

Hemlock twig rust. Experimental work on the control of the hemlock twig rust caused by Melampsora farlowii has been started. Bordeaux mixture and lime sulphur sprays, and copper and sulphur dusts are being used. The best control results so far have been obtained with lime sulphur. Successful inoculations with the rust were completed this month, thus establishing it as the cause of the disease. The following fungi have been found associated with a die-back and canker of young hemlock. Excipulina obscura, Gelatinosporium abietinum, Pestalozzia funerea, and Phoma sp.

Appalachian (cont'd)

Time of Death of Girdled Tree. Examination of trees girdled on timber stand improvement operations in hardwoods indicate that the average size of the three largest limbs broken off is a useful criterion for determining how long trees have been dead. For trees girdled 4 years ago and 6 to 10 inches d.b.h. the larger limbs broken off average roughly between 1.5 and 2.0 inches, and for trees over 10 inches d.b.h. they average from 2.1 to 3.0 inches. Other useful criteria are age of sprouts, age of fire wounds on adjacent living trees, in the case of fire-killed timber, and the fungi present on the bark. This information was obtained for the use of the forest survey in determining mortality.

Brown-spot Needle Blight. Most of the month was spent at Washington, D. C., in a study of herbarium specimens including type material of the fungus causing the brown-spot needle blight of longleaf pine and its pathological relatives.

Native Canker-forming Rusts. Preliminary conclusions in a study of the relative susceptibility of scrub oaks to rust infection are that the white oaks as a group can be disregarded as carriers of the southern gall-forming rusts. On the other hand the black oaks are the principal offenders in this respect. A statistical analysis of rust infection on the oaks is being worked up in terms of number of telia per leaf and per square inch of leaf surface. More data will need to be gathered before we can obtain a reliable figure of the relative susceptibility of the several species of black oaks to infection.

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NORTHEASTERN FOREST EXPERIMENT STATION

Report for May-June 1938.

(Received Too Late For Classification)

FOREST MANAGEMENT

SILVICULTURE

White Ash Reproduction. A check was recently made on the number of white ash seedlings which had become established in stands on the Bartlett Experimental Forest following the excellent seed crop of 1937. Counts were made on reproduction strips established in connection with methods of cutting plots and consequently the proximity and number of seed trees was not strictly comparable on the several areas. Had the seed supply been equalized on all areas the differences would have been less pronounced, although ground cover and shade from the overstory appeared to be far more important factors.

Areas which had been clearcut from three to five years and supported a rank growth of reproduction (sprouts and seedlings including a fair representation of white ash), pin cherry, raspberry, and blackberry provided very unfavorable conditions for the establishment of ash. In spite of an ample supply of seed from the scattered seed trees and ash bordering the cutting areas, very few seedlings survived two months after germination; the exceptions occurred where there was little or no competing ground cover. Although not uniformly distributed over the areas, approximately 1,500 ash seedlings per acre were tallied on the areas clearcut from 1 to 2 years. The limited size of the more recently cutover areas (0.2 to 0.4 acres) was doubtless an important factor as conditions were less favorable to the development of sprouts, cherry, etc., which had largely taken over the older 25 acre clearcutting at this stage of its development. The number of ash seedlings occurring in undisturbed many-aged northern hardwood stands similar to the clearcut areas was negligible.

Conditions were very favorable to the establishment of white ash in 60-year even-aged northern hardwood stands. Tallies on these areas included untreated stands and also areas on which two years previously about 20 and 30 percent of the volume had been removed in making a thinning. The undisturbed stands of this age presented a practically unbroken over-story and relatively sparse ground cover in contrast with the somewhat irregular canopy and abundant advance growth on the many-aged areas. On the plots where 20 percent of the volume was cut, seed-bed conditions were improved although an additional 10 percent removal appeared to be desirable from this standpoint.



The cutting in neither case was drastic enough to establish or stimulate the growth of any considerable proportion of the less desirable species. Sampling indicated that approximately two, eight, and twenty thousand new seedlings had become established on the check, Twenty percent thinning and thirty percent thinning, respectively.

In general, ash seed was more abundant and more soil moisture available in the 60-year than the many-aged stands, but these differences as indicated by small samples were not alone sufficient to account for the wide variation in stocking on the two types.

Cruise Plotwork; Massabasic Experimental Forest. Under the supervision of Cultural Foreman Hardy, cruise plot work was resumed during the first week in June. The southern unit is now practically completed and work in the northern unit will begin in the near future. Practically all the cruise plot work is being done by C.C.C. enrollees under the direction of a technical forester. Morey has developed a system for this work which gives very satisfactory results. Five separate units, each performing a definite task, make up the crew.

Cruise line establishment unit	4-6 men
Plot establishment unit	3 "
Cruise plot tally unit	2-3 "
Reproduction tally unit	2 "
Heights and increment boring unit	2 "

Soil Fauna: The analysis of litter sample 37 Fl, from undisturbed, long unburned spruce woodlands of the White Mountains has been completed. Its one square foot area yielded 20,250 microarthropods (representing 190 species) and 17 minute earth worms of the family Enchytraeidae (2 species).

Of these, 13,528 (108 species) are saprophagous; 4,016 (47 species) are predators; and 2,707 (35 species) are suckers and parasites. It was found that in a few easily recognized species of mites the ration of young to adult is 6 to 1. This means that 45,000 immature mites were not recovered by this drying method. It is known that the immatures of some species of mites live within decaying spruce and fir leaves and within decaying wood. These would dry up and die in place on the drying funnels. This accounts for part of the loss. Since adults may be taken as an indication of the success of the species, hereafter all counts of immature mites will be disregarded. The sample yielded 9,929 saprophytic mites (56 species) and 2,856 saprophytic springtails (25 species). The outstanding absentees were millipedes (1 immature was recorded) and earth worms of the family Lumbricidae.

Of the suckers, 15 species (2,183 individuals) belong to the genus *Suctobolbella*. We do not know what they live on though it

maybe fungal hyphae. If they suck the sap of rootlets they might be of considerable importance in slowing tree growth. In the future these suckers will not be studied as they do not contribute directly to the reduction of the humus, though they may affect the humus conditions somewhat if they inhibit fungal action to any extent. This genus is common in all litters though the species vary somewhat from place to place.

A large number of pigmentless and eyeless predators were found in the H-layer. Moreover, species are not evenly distributed over the forest floor, so that cuts taken 10 or 15 feet apart under apparently uniform conditions, include species not present in all three cuts. In some instances a species may be common in one cut and not in the other two. This is not correlated with presence and absence of old decaying wood in the litter.

It may, therefore, be better technique to take 5 cuts each 6" in diameter than 3 cuts 8" in diameter. The total surface area would be the same. It would require more driers which could be built only 7" in diameter (instead of the present 15").

Epistomalyicus, a common mite formerly regarded as predaceous, was found to eat chiefly fungal mycelia (dead or alive?).

The litter reducing fauna is adequate but the humus reducers are scant.

FIRE PROTECTION

Rate of Spread: Although it was hoped that an exception would be made for our experimental fire work, the Massachusetts ban on open fires was strictly enforced during the entire month of May. The abundant precipitation during May had so materially altered fuel moisture conditions and promoted the regrowth of grass and herbaceous vegetation on the slash plots that early in June it was decided to discontinue the rate of spread study because any burning data secured at this late date would not be typical of conditions during the normal fire season.

Forest Fire Weather: The Weather Service of the Yankee Network, a major eastern radio chain, has requested the assistance of the Station in the initiation of a forest fire-weather forecast service. The headquarters of the Weather Service is located in Boston where a first-class meteorological station is maintained in charge of two trained and experienced meteorologists. The Weather Service issues twice daily independent weather forecasts over the radio which are based on master weather maps prepared at the Massachusetts Institute of Technology. Through radio communication this private agency obtains all the weather data that are broadcast hourly by the airways weather service, and is in a position to prepare additional regional

weather maps and forecasts if conditions warrant. The Service is anxious to enter the field of forest-fire-weather forecasting and is willing to issue localized forecasts that take into account fuel moisture conditions as well as the important weather elements. In assisting the Weather Service in this undertaking, the Station will act as a liaison office in contacting the various forest fire control organizations in the region and in indicating the type of data that should be included in the forecasts.

FOREST ECONOMICS

PRIVATE FORESTRY

Cooperstown Project: The work of the private forestry project at Cooperstown, New York, centering around the Otsego Forest Products Cooperative Association, Inc., has been intimately concerned with development of operating methods during the past winter. The Association was unable to complete work on the main processing plant before the winter season. A small circular mill, originally set on the site to cut construction materials, was enlarged by addition of an edger and trimmer, and an operating program based on this equipment was undertaken. Log grades were established on the basis of the 1937 Forest Products Laboratory studies in New York State and logging contracts entered into with approximately 100 farmers. Due to time limitations, some of these contracts were not completed but 86 members logged and delivered to the plant about 700,000 feet log scale of various species of logs. About 40 percent of the deliveries were hemlock, 20 percent beech, 12 percent sugar maple, 6 percent red oak, and 6 percent white pine. The remainder was white ash, basswood, yellow birch, elm, soft maple, and blackcherry. With a few exceptions, all this timber was cut from stands which had been marked for a 10 to 15 percent selective cut. In a few cases a heavier cut (about 30 percent) was made to allow the member to meet financial emergencies. The Forest Products Laboratory cooperated in making a study of the mill operation to determine lumber grade output as a basis for checking scaling and grading practice. The observations not only indicated the inadequacy of the set-up for manufacturing the range of logs encountered accurately and efficiently, but also for taking the greatest possible portion of the material suitable for industrial use from the woods. At least 15 percent additional industrial wood suitable for sawing could have been taken from the members if the Association had been equipped to process it.

In the process of carrying on operations, the Station has supervised the development and use of a complete modern set of accounts which will give accurate costs at all points where production is measured. Due to the preliminary nature of operations, the Association itself undertook no logging operations, all this work being handled by the farmers or men employed by them. The Association maintained and placed at the disposal of the members a roster of qualified loggers and truckmen. The 86 farmers received nearly \$14,000.00

for the materials delivered. In addition, tops and poor trees were cut up into fuelwood which they disposed of themselves. An average possible return for farmers cannot be determined because of the fact that a number of the members did not cut through their entire wood-lot this year; others cut sawtimber only, reserving fuelwood trees for later cutting, while others cut the entire amount marked. Most of the members were satisfied with the type and amount of cut. The season's operations were very valuable in indicating the type of problems which the Association must solve before its raw material acquisition program is on a sound basis.

FOREST AND RANGE INFLUENCES

Soil Freezing. In the fall of 1937 measurements of depth of frost in the ground were initiated on the Gale River Experimental Forest in order to follow the difference in soil freezing in the open field and under forest cover. The purpose of last winter's work was to develop and test tools and equipment for ground frost measures and to secure a basis for planning of future investigations on a larger scale. The results of some of these measurements, however, may be of interest because, although they do not make a complete picture, they show definite trends in the type of freezing under different conditions.

Three sample areas were established on the Gale River Experimental Forest, and periodic measurements were made on each one from the time of first freezing until frost was out of the ground.

Area No. 1. Open field: Gently sloping to the West. Well drained sandy loam. Covered with grass, not in continuous mat but in tufts leaving relatively small, though not numerous, bare spots. Grass was mowed in summer of 1937 and by the end of growing season it was 5-6" high.

Area No. 2. Black spruce swamp: Level ground. Dense stand of black spruce 3-6" with admixture of tamarack. Ground cover, sphagnum moss. Litter, 1/4-1/2" thick. Humus of sponge-like consistency (friable) merging into peat 3-4' deep.

Area No. 3. Spruce and fir stand: Age of stand, 65 years. Average d.b.h. 6". Density, 0.7. Ground gently sloping to flat, well drained. Ground cover moss, debris, few hardwood leaves. Litter, negligible (1/6-1/6"). Soil, sandy loam podzol. Humus layer 2-5". Podzol 1/4-2".

By early winter it was evident that a correlation existed between cover and soil freezing. In the open field the soil started freezing earlier than under the forest cover and also proceeded at a more rapid rate during the first month. The type of freezing,

however, appeared to be more important than the depth or rapidity. In the open the soil was frozen solidly and appeared impermeable. Under the forest canopy the water formed snowlike crystals while the soil remained friable and appeared porous.

Measurements after a 1.78" rainfall demonstrated the influence of the rain on soil freezing. Before the rain the soil was frozen to a depth of 4" in the open, $2\frac{1}{2}$ " in the swamp, and $1\frac{1}{2}$ " in the well drained area (spruce stand). In the open the rain thawed the soil to a depth of only $1\frac{1}{4}-\frac{1}{2}$ " while under the forest canopy there were many places where the frost had disappeared entirely. Such frozen patches as were found under the forest canopy seemed to have little effect on permeability as the soil was saturated and the water was permeating freely through the frozen soil.

In the middle of the winter the effect of a heavy rain on thawing the surface layer of the frost in the ground was practically uniform in all three cases. However, the frost in the swamp consisted of snowlike crystals in the upper layer and ice crystals in the lower, before and after the rain. Under the spruce canopy in the upper layers (organic and podzol) the frost was in snowlike crystals; in the lower layer the frost was solid.

After about one month the depth of the frost in the open and under the forest cover was about the same and continued so until the spring thaw.

The spring thaw started about March 27 and by April 28 there was no frost in the ground on the sample area in the open. The thawing proceeded from the top as well as from the bottom of the frost layer. Due to too few measurements during this period, it is hard to say whether the thawing proceeded more rapidly from the top or from the bottom.

Thawing under the spruce stand was slower. At first, it thawed more rapidly from the top than from the bottom, but before complete disappearance, the bottom was thawing more rapidly so that the last frost was found about midway between the surface and the lowest limit of the frost. The last frost disappeared some time between May 26 and May 30.

Thawing in the swamp was still slower, proceeding from the surface and from the bottom at about the same rate. The last frost was found in a nearly continuous layer of 2-3" thickness on the sample area as late as June 30 when the measurements were discontinued. Elsewhere in the swamp the frost in the ground was in patches due probably to differences in drainage and density of canopy. It was noticed that drainage plays an important role in rapidity of thawing; the better drained soil was free from frost much earlier than the poorly drained soil.

FLOOD CONTROL SURVEYS

Blackstone and Merrimack Rivers. A sub-committee composed of Messrs. Cubbon of the Soil Conservation Service, Mr. Derr of the Bureau of Agricultural Economics, and Mr. Roberts of the Forest Service, prepared a draft of the preliminary examination report for the Blackstone River to present to the field Flood Control Coordinating Committee in the near future. Preparations are being made to start the preliminary examination work on the Connecticut and Hudson rivers. The report for the Merrimack River is being worked up in rough draft form.

